FIG. 1A   CDMA Transmitter: Block Diagram

9
User
data
words

10
Frame
Processor

*Inner code
*Outer code
*CRC code
*Frame

11
Symbol
Encoder

•Gain
 adjust
•Amplitude
 encode
•Phase
 encode

13
Current real Walsh
CDMA encoding

CDMA encoding
* Real Walsh
* Real PN
* Complex PN
* Complex
  Signal

15
Modulator and
Transmitter

Complex
Signal
Modulator
And
Transmitter

Tx
waveform

$Z(n)$ **14**

16

$v(t) =$
$Real\{z(t)\, e^{j(2\pi f_0 t + \phi)}\}$

12

User data symbols

$= \{Z(u)\} = R(u_R) + jI(u_I)\}$

For complex data symbols $u = u_R = u_I$

For real data symbols $u = $ index for

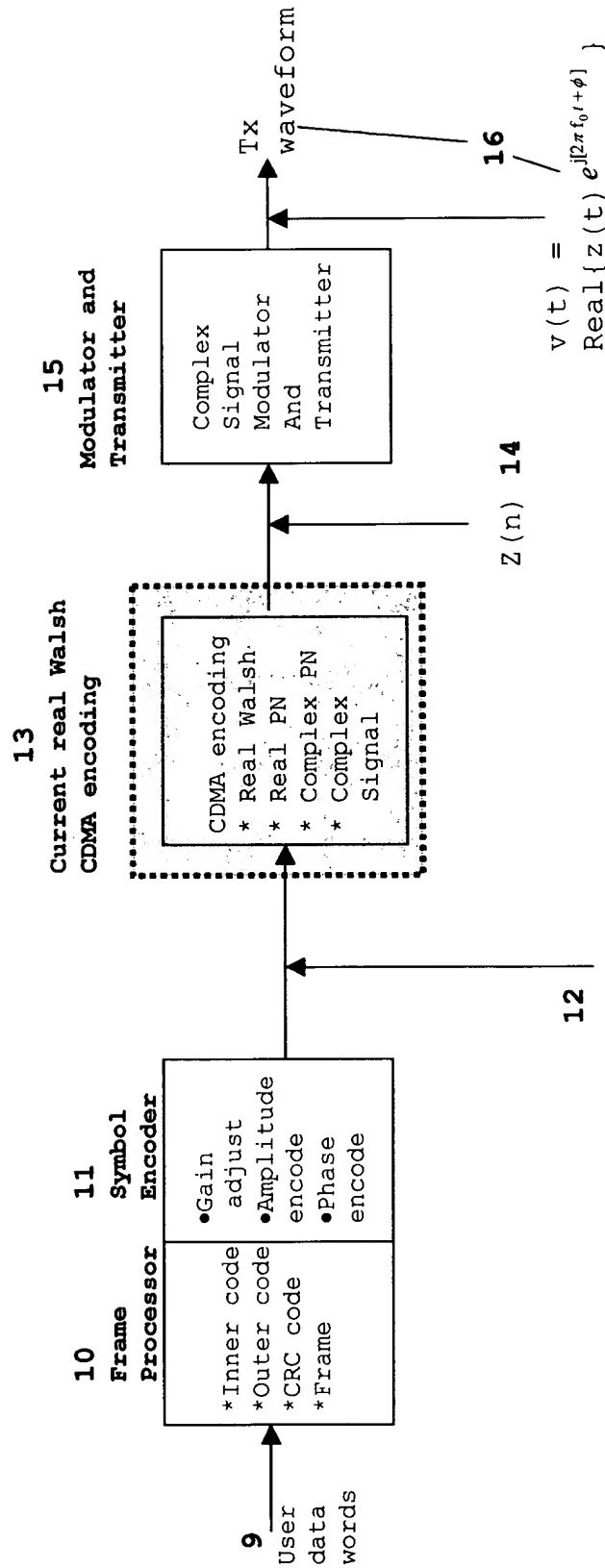counting the user pairs (u_R, u_I)

FIG.1B in the amendment drawings is added to help explain FIG. 1A.

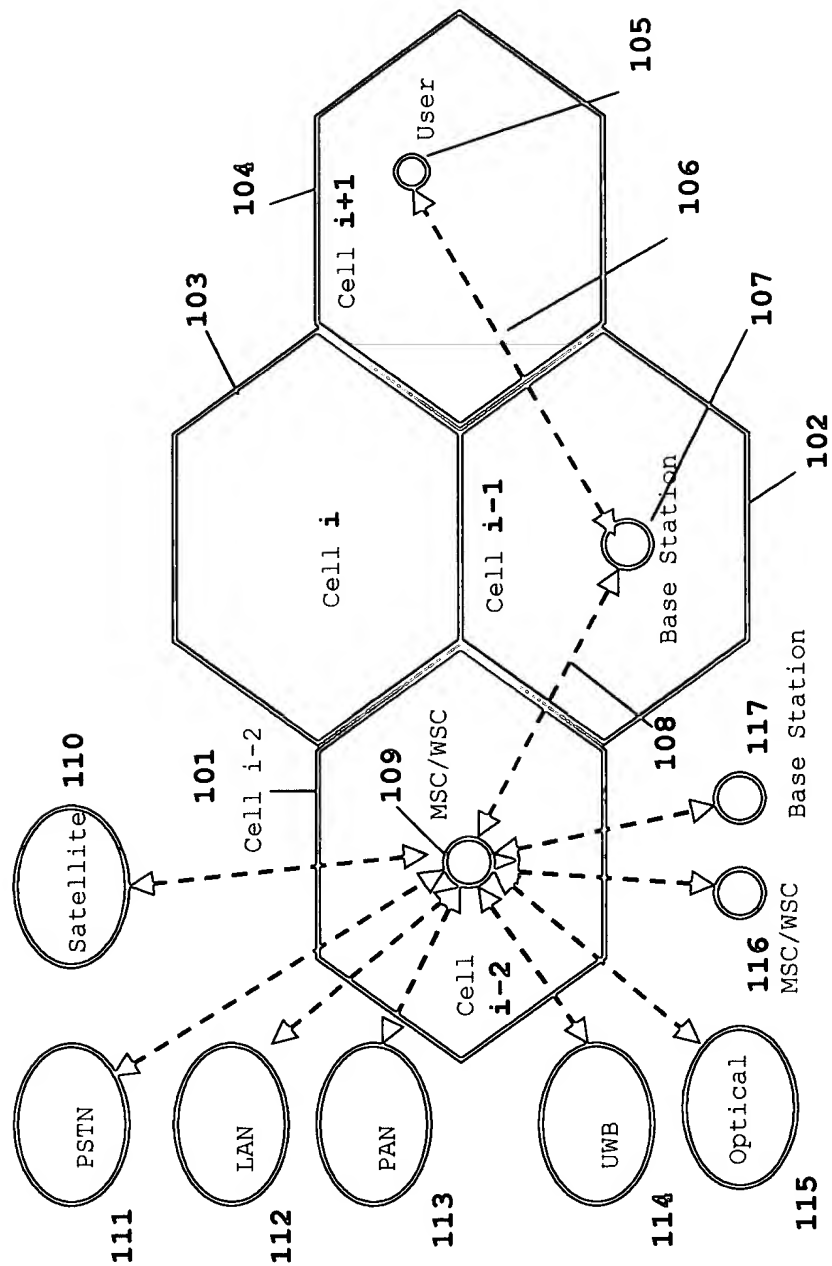FIG. 1B CDMA Transmitter: Cellular Application

FIG.1C in the amendment drawings is added to help explain FIG. 1A.
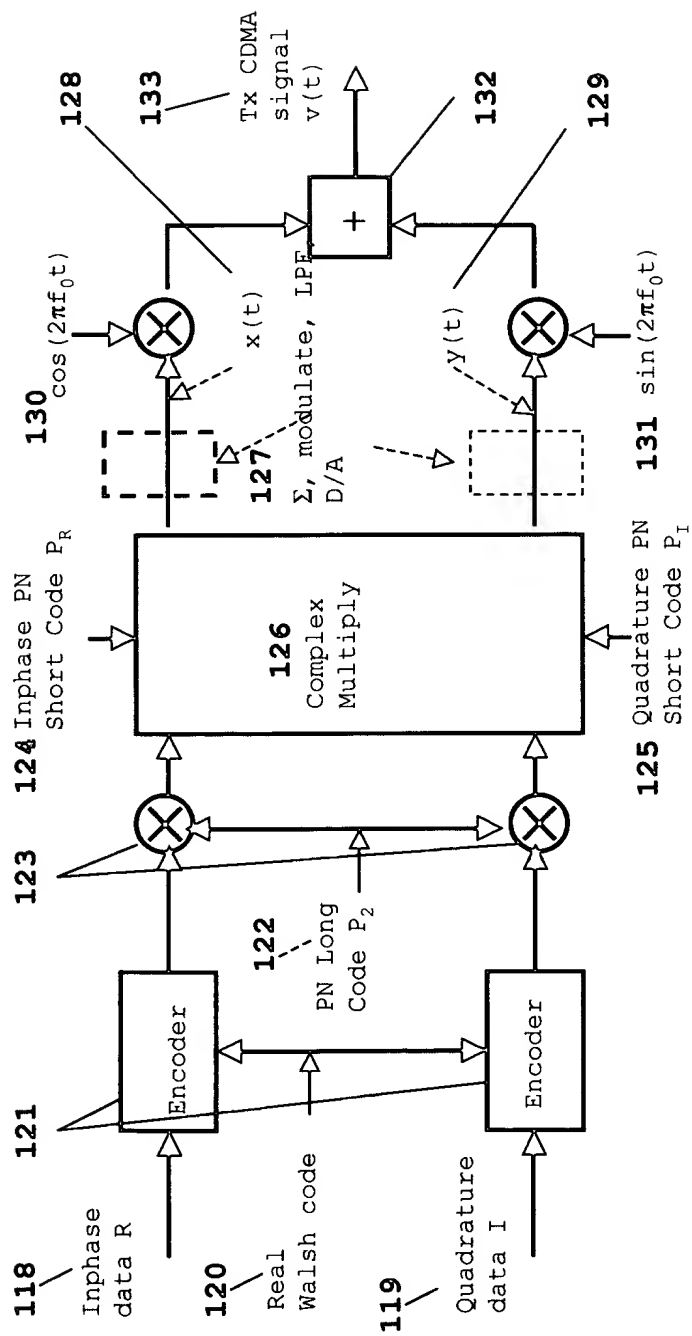
FIG. 1C CDMA Transmitter: Cellular Implementation

FIG. 2 in the amendment drawings is unchanged.
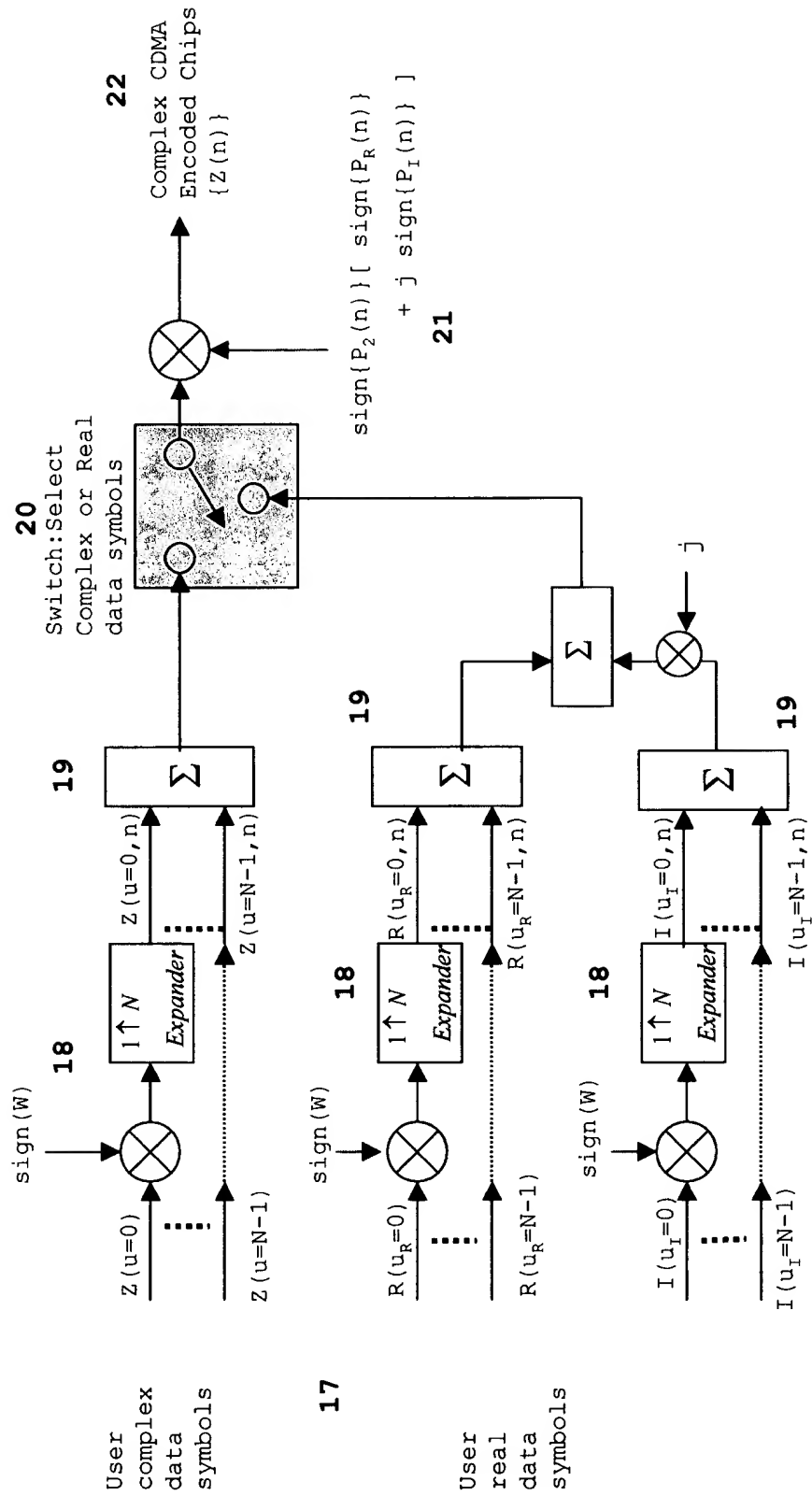
FIG. 2 Real Walsh CDMA Encoding Implementation

FIG.3A in the amendment drawings is FIG. 3 in the original submittal.

7

FIG. 3A CDMA Receiver: Block Diagram

24 Analog Front End
- Receive and Down-convert

25 Synch. and ADC
- Time and frequency synch.
- Analog-to-digital conversion

26 Chip Detector
- Inphase, Quadrature Chip Detect

27 Current real Walsh CDMA decoding

CDMA Decoding:
* Real PN
* Complex PN
* Real Walsh
* Complex signal

30 Symbol Decoder
- Amplitude & phase decode

31 Frame Processor
- *CRC error detect
- *Outer decode
- *Inner decode
- *Frame unpack

32 Receiver Estimates of Transmitter user data words

Users
u=0
· · · · ·
$n_u \leq N_c - 1$

23

Rx waveform
$\hat{v}(t) = Real\{\hat{z}(t+\Delta t)\, e^{j[2\pi(f_0+\Delta f)t + \Delta\theta]}\}$

28

$\{\hat{Z}(n) = \hat{R}(n) + j\hat{I}(n)\}$

29

User data symbol estimates

$\{\hat{Z}(u) = \hat{R}(u_R) + j\hat{I}(u_I)\}$

For complex data symbols $u = u_R = u_I$

For real data symbols $u =$ index for counting the user pairs $(u_R,\ u_I)$
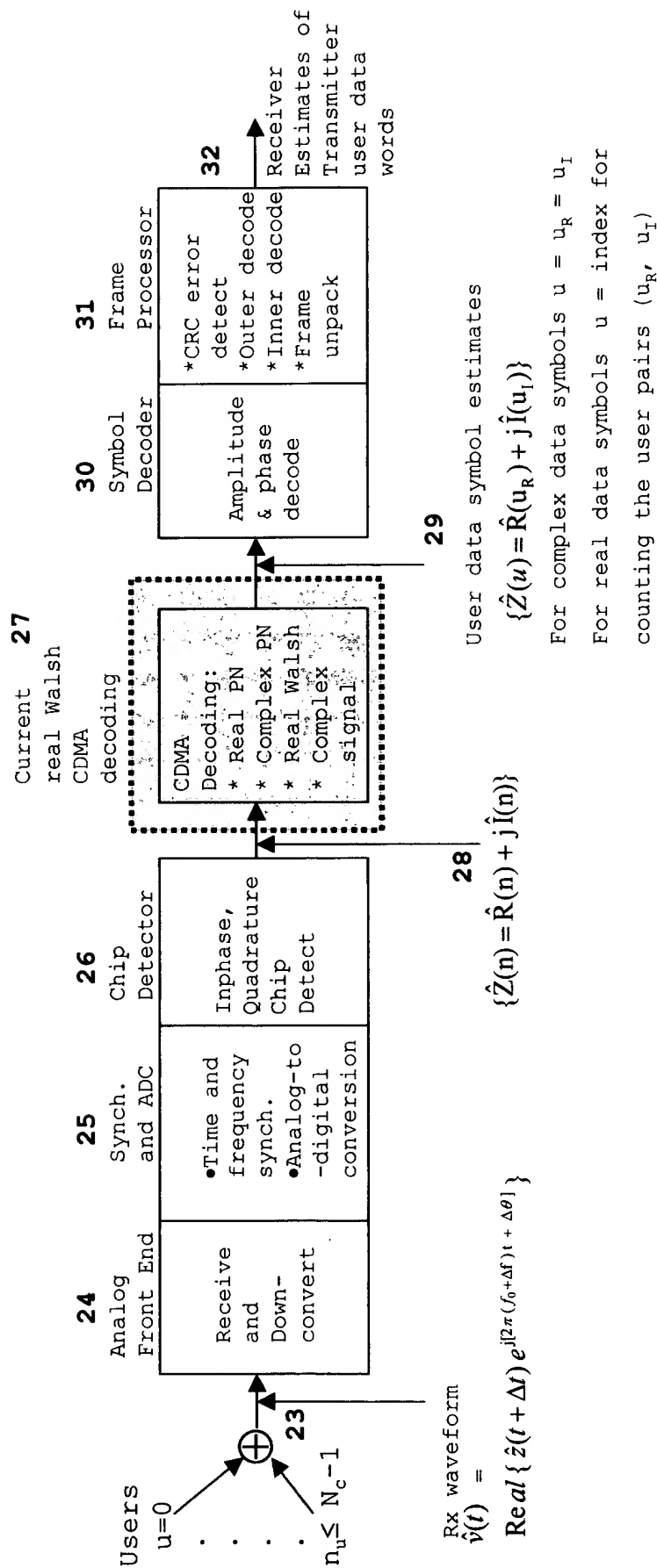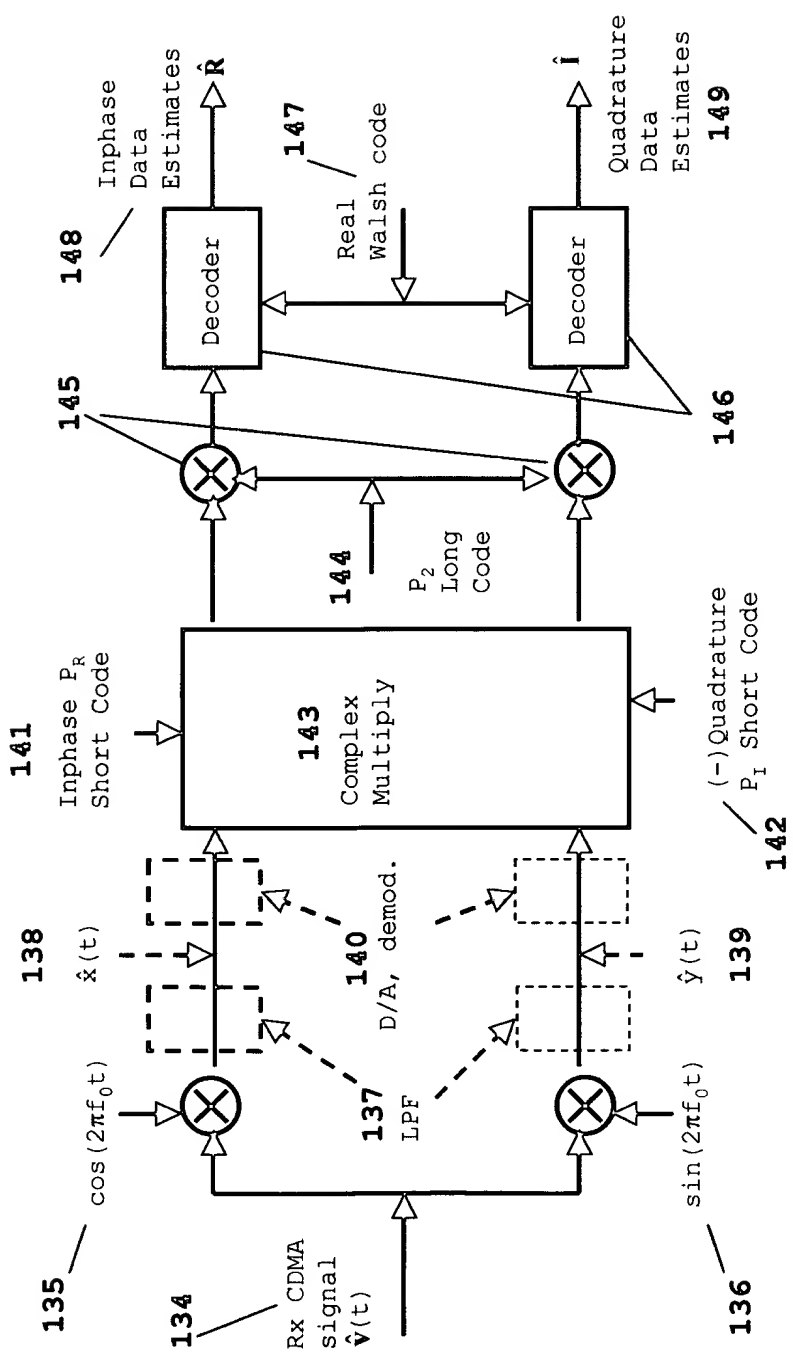
FIG. 3B in the amendment drawings is added to help explain FIG. 3A.

FIG. 3B CDMA Receiver: Cellular Implementation

FIG. 4 in the amendment drawings is unchanged.

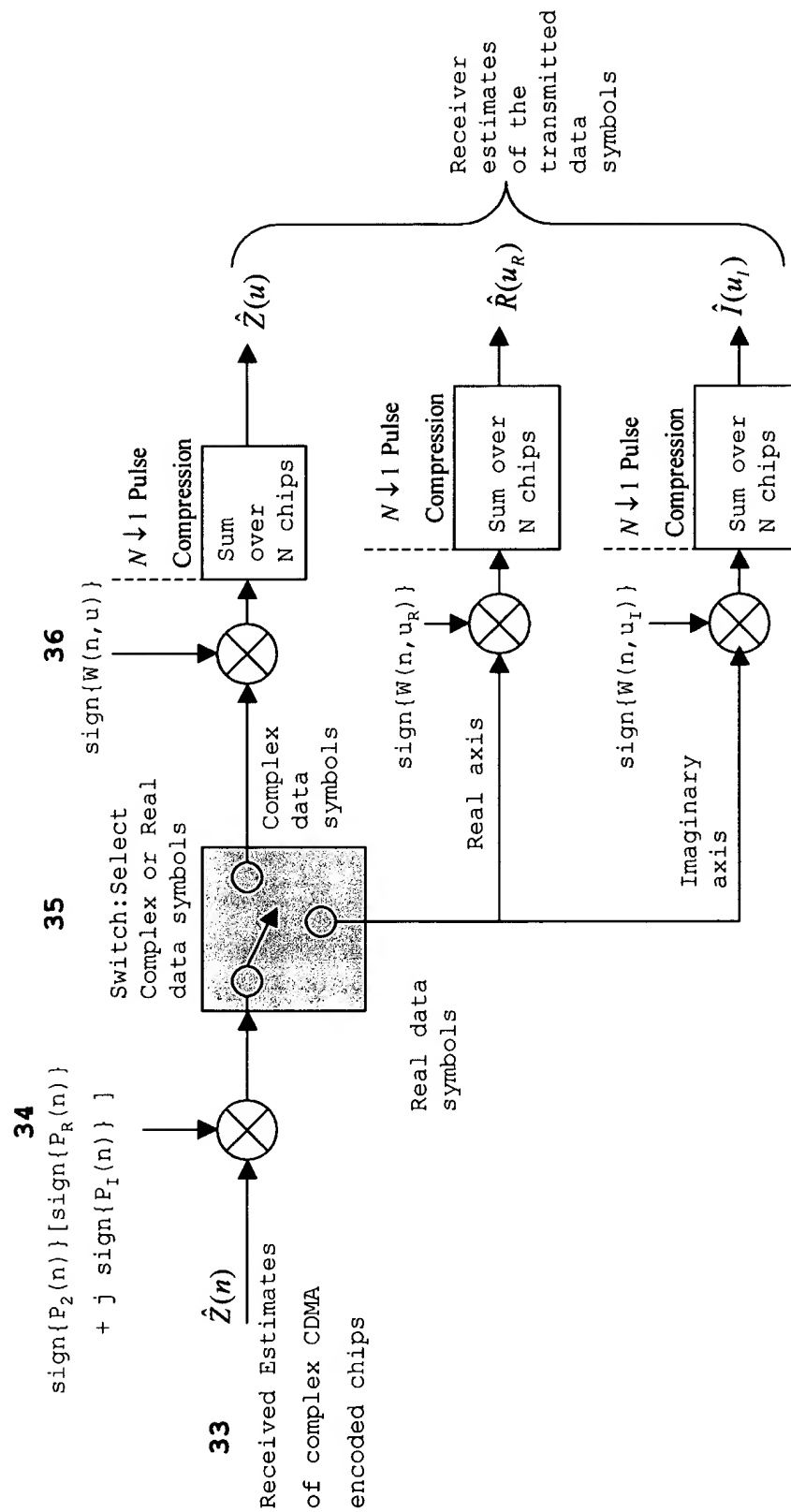# FIG. 4 Real Walsh CDMA Decoding Implementation

Receiver estimates of the transmitted data symbols

$\hat{Z}(u)$

$N\downarrow 1$ Pulse Compression

Sum over N chips

$\hat{R}(u_R)$

$N\downarrow 1$ Pulse Compression

Sum over N chips

$\hat{I}(u_I)$

$N\downarrow 1$ Pulse Compression

Sum over N chips

36

$sign\{W(n,u)\}$

$sign\{W(n,u_R)\}$

Real axis

$sign\{W(n,u_I)\}$

Imaginary axis

35

Switch:Select Complex or Real data symbols

Complex data symbols

Real data symbols

34

$sign\{P_2(n)\}[sign\{P_R(n)\}$

$+ j\ sign\{P_I(n)\}\ ]$

33 $\hat{Z}(n)$

Received Estimates of complex CDMA encoded chips

FIG. 5 in the amendment drawings is unchanged.

FIG. 5 Correlation of Fourier Codes
with DFT Codes for N=32
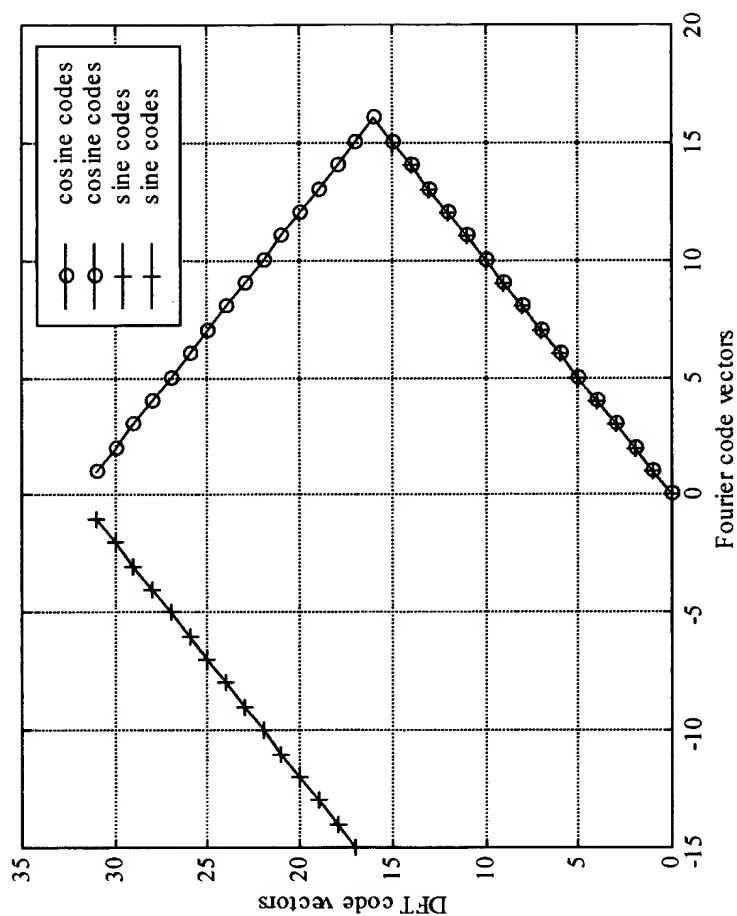
FIG. 6A in the amendment drawings is FIG. 6 in the original submittal.
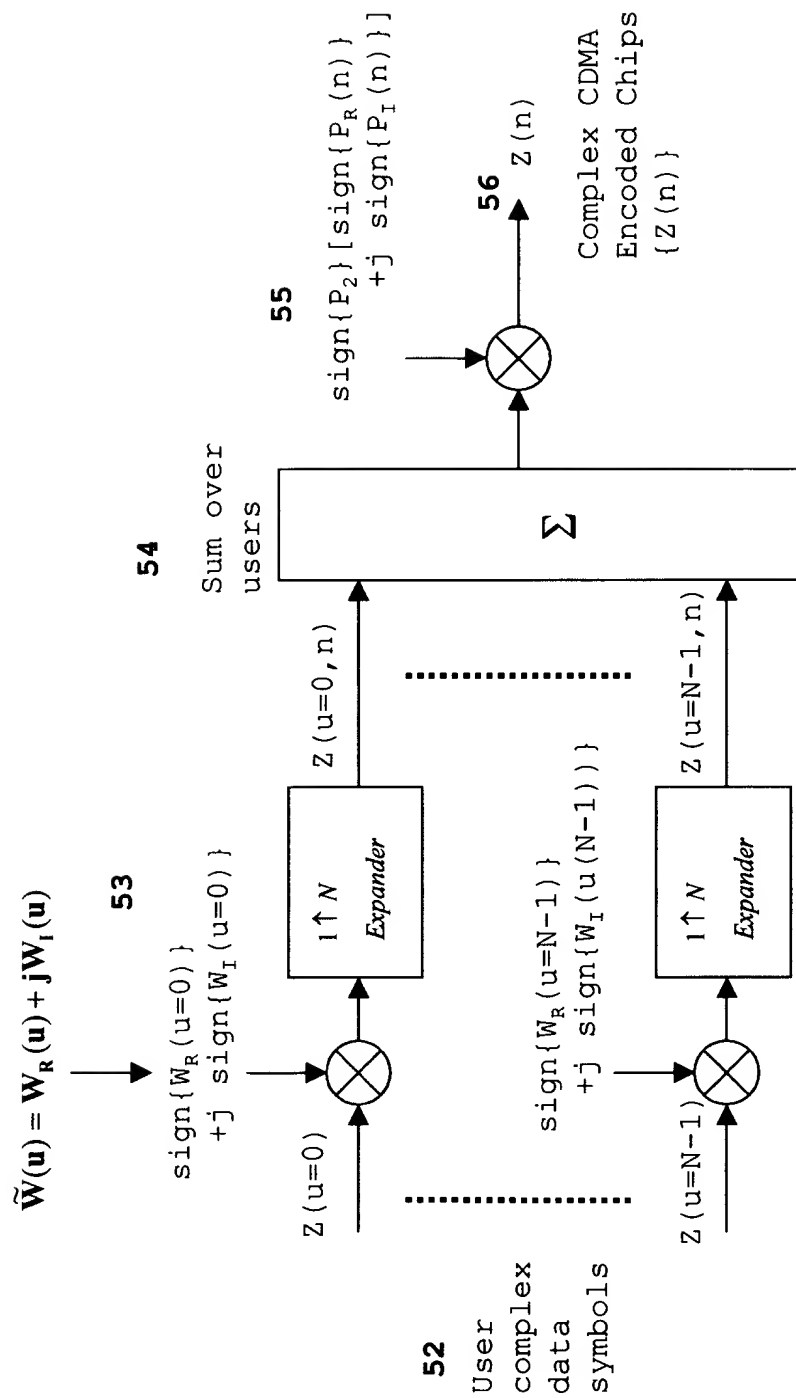
FIG. 6A Hybrid Walsh: CDMA Encoding Implementation

$\tilde{W}(u) = W_R(u) + jW_I(u)$

53

sign$\{W_R(u=0)\}$
$+j$ sign$\{W_I(u=0)\}$

$Z(u=0)$

$1\uparrow N$
Expander

$Z(u=0,n)$

sign$\{W_R(u=N-1)\}$
$+j$ sign$\{W_I(u(N-1))\}$

$Z(u=N-1)$

$1\uparrow N$
Expander

$Z(u=N-1,n)$

52
User
complex
data
symbols

54
Sum over
users

Σ

55
sign$\{P_2\}$[sign$\{P_R(n)\}$
$+j$ sign$\{P_I(n)\}$]

56
$Z(n)$

Complex CDMA
Encoded Chips
$\{Z(n)\}$

FIG. 6B in the amendment drawings is added to help explain FIG. 6A.

FIG. 6B Hybrid Walsh: Implementation Algorithm

Sequency index	Hybrid Walsh inphase (real) code vector $W_R(u)$	Hybrid Walsh quadrature (imaginary) code vector $W_I(u)$
$u = 0, 1, \ldots, N-1$	Hybrid Walsh reordering permutation of the real Walsh code vectors	
$u = 0$	$W_R(u) = W(0)$	$W_I(u) = W(0)$
$u = 1$ to $(N/2-1)$	$W_R(u) = W(2i)$	$W_I(u) = W(2i-1)$
$u = N/2$	$W_R(u) = W(N-1)$	$W_I(u) = W(N-1)$
$u = N/2+\Delta u$ for $\Delta u=1$ to $N/2-1$	$W_R(u) = W(N-1-2\Delta u)$	$W_I(u) = W(N-2\Delta u)$

167   168   169

FIG. 6C in the amendment drawings is added to help explain FIG. 6A.

FIG. 6C Hybrid Walsh: Implementation Algorithm Based on Even and Odd Real Walsh Codes

Hybrid Walsh reordering permutation of the even and odd Walsh code vectors — 171

Sequence index	Hybrid Walsh inphase (real) code vector $W_R(u)$	Hybrid Walsh quadrature (imaginary) code vector $W_I(u)$
$u = 0, 1, \ldots, N-1$		
$u = 0$	$\underline{W}_R(u) = \underline{W}_e(0)$	$\underline{W}_I(u) = \underline{W}_e(0)$
$u = 1$ to $N/2-1$	$\underline{W}_R(u) = \underline{W}_e(u)$	$\underline{W}_I(u) = \underline{W}_o(u)$
$u = N/2$	$\underline{W}_R(u) = \underline{W}_o(N/2)$	$\underline{W}_I(u) = \underline{W}_o(N/2)$
$u = N/2+\Delta u$ for $\Delta u = 1$ to $N/2-1$	$\underline{W}_R(u) = \underline{W}_o(N/2-\Delta u)$	$\underline{W}_I(u) = \underline{W}_e(N/2-\Delta u)$

170

172

FIG. 6D in the amendment drawings is added to help explain FIG. 6A.

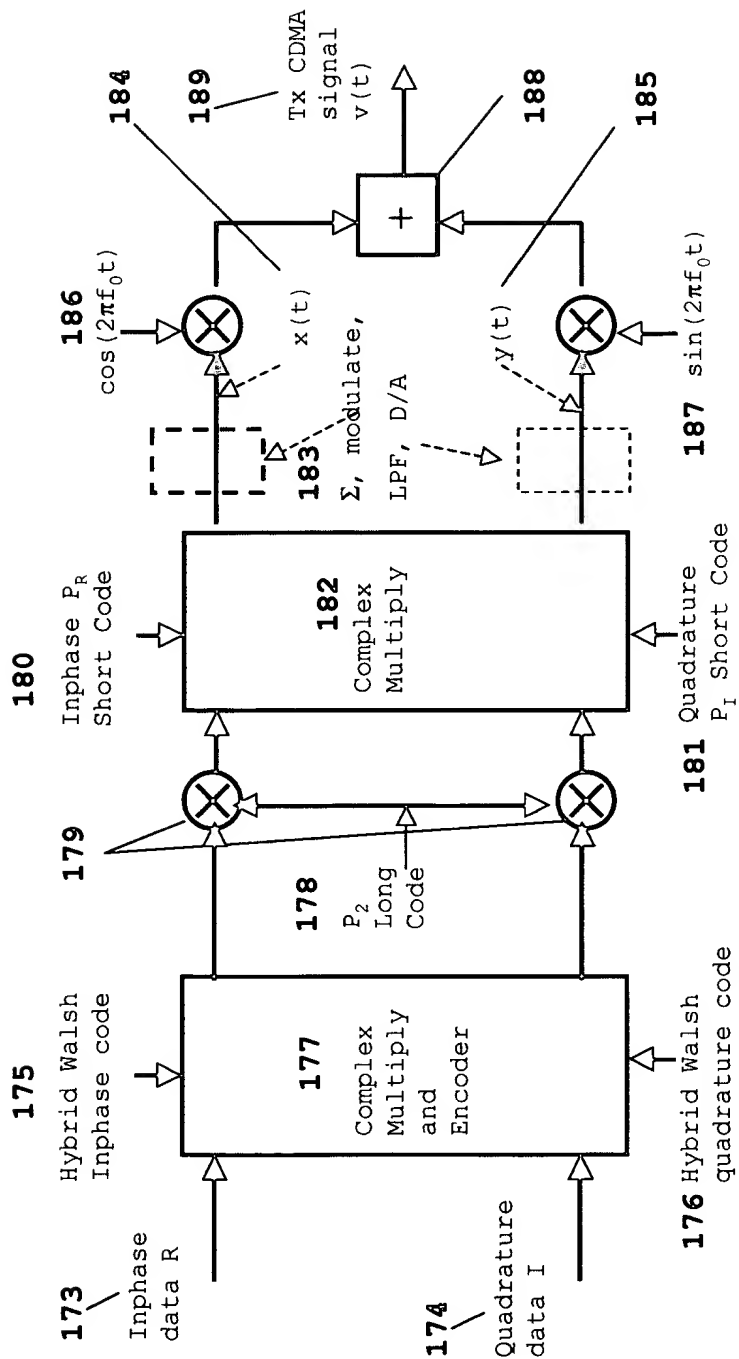# FIG. 6D Hybrid Walsh: Cellular Transmitter Implementation

FIG. 7A in the amendment drawings is FIG. 7 in the original submittal.

FIG. 7A Hybrid Walsh CDMA Decoding Implementaion

$\widetilde{W}(u) = W_R(u) - jW_I(u)$

59

$\text{sign}\{W_R(u=0)\}$
$+j\ \text{sign}\{W_I(u=0)\}$

$N\downarrow 1$ Pulse Compression

Sum over N chips

$\hat{Z}(u=0)$

$\text{sign}\{W_R(u=N-1)\}$
$+j\ \text{sign}\{W_I(u=N-1)\}$

$N\downarrow 1$ Pulse Compression

Sum over N chips

$\hat{Z}(u=N-1)$

60
Receiver estimates of the transmitted data symbols

58
$\text{sign}\{P_2(n)\}\,[\text{sign}\{P_R(n)\}$
$-j\ \text{sign}\{P_I(n)\}\,]$

$\hat{Z}(n)$

57
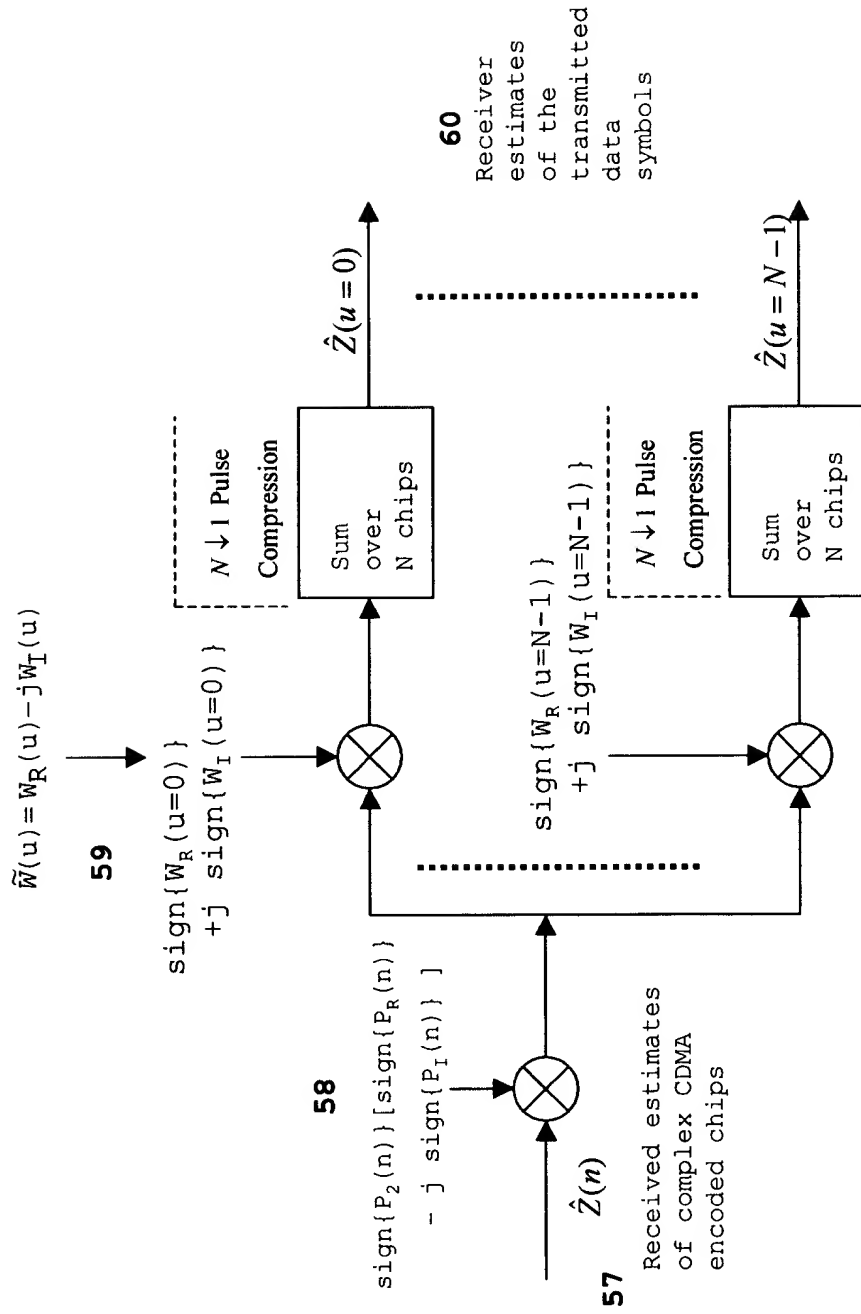Received estimates of complex CDMA encoded chips

FIG. 7B in the amendment drawings is added to help explain FIG. 7A.

FIG. 7B Hybrid Walsh: Cellular Receiver Implementation